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ABSTRACT

This qualitative study explored college teaching in an "apprenticeship" setting, specifically the architectural design studio. The study examined studio teachers' efforts to design effective project assignments and to help students move successfully through those assignments. Two design teachers were interviewed and observed as their students worked for 10 weeks on an urban design problem. The study's findings addressed both project design and teaching strategies. The study found that a good project assignment serves multiple purposes; rests in a theoretical frame that can be generalized to other problems; builds on and meshes with the existing curriculum while providing new opportunities as well; is prototypic; employs the studio product as a learning technique itself; and uses project presentations not only to communicate results but as a way for thinking through the design process. Strategies for helping students learn from project assignments include making arrangements so students can engage and pursue the task, influencing how students think about the problem, diagnosing students' progress and shaping their problem, structuring the project requirements, simultaneously opening its opportunities and focusing students' thinking, and improvising. (Author/JDD)

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THE ESSENCE OF TEACHER THINKING AND PLANNING IN PROFESSIONAL SCHOOLS' "APPRENTICE" SETTINGS

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The author is grateful to the committed and eloquent teachers who served as the subjects of this research, to Stefinee Pinnegar (Western Michigan University) for her participation in the study, and to Virginia Richardson (University of Arizona) for her wise counsel.

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ABSTRACT

This study of college teaching in an "apprenticeship" setting -- the architectural design studio -- rested theoretically in educational research on teacher planning, teacher beliefs, and academic tasks, as well as extending the recent research on studio teaching. Because tangible task assignments provide the context in which most apprenticeship learning takes place, the study examined studio teachers' efforts to design effective project assignments and to help students move successfully through those assignments. The investigation employed qualitative data from three sources.

The study's findings addressed both problem design and teaching strategies. A good project assignment serves multiple purposes, rests in a theoretical frame that can be generalized to other problems, and buildings on and meshes with the existing curriculum while providing new opportunities as well; it is prototypic, employs the studio product as a learning technique itself, and uses project presentations not only to communicate results but as a way for thinking through the design process. Strategies for helping students learn from project assignments include making arrangements so students can engage and pursue the task, influencing how students think about the problem, diagnosing students' progress and shaping their problem, structuring the project requirements, simultaneously opening its opportunities and focusing students' thinking, and improvising.

THE ESSENCE OF TEACHER THINKING AND PLANNING IN PROFESSIONAL SCHOOLS' "APPRENTICE" SETTINGS

The research on college teaching examining instructional strategies such as lectures, laboratories and discussion is disappointing to educators in professional fields because it fails to address important forms of instruction used in professional schools. Curricula in professional education emphasize instruction in "apprenticeship" settings such as the engineering cooperative education experience, the journalism editorial writing course, the music performance course, or the design studio. These courses are distinguished by the student's independent work on assigned tasks, and by the individual relationship with the teacher, who acts in many capacities including those recently explicated by Schon (1987) and others following his lead. Important though apprentice instruction may be, however, only a few professional fields have developed a separate, theory-based research literature about their unique forms of teaching (Dinham & Stritter, 1986; O'Neil, Anderson, & Freeman, 1986).

In our long-term research on professional education, the field of design is currently under examination as an exemplar of fields in which the "apprenticeship" is at the core of the curriculum. Thus far those examining design teaching (Anthony, 1987; Bray, 1988; Dinham, 1987) have concentrated on teachers' interactive instruction. In contrast, the present work examined how teachers plan teaching through the project assignment. Because such assignments form the context for virtually all of the learning occurring in these "apprentice" settings, the quality of these assignments' design and the skill with which teachers plan and implement the assignments are crucial to students' learning. Unlike more traditional college-level instruction in which a disorganized lecture might be merely uncomfortable, in apprenticeships a poorly conceived project assignment can rob students of important learning for an entire term. The investigation's generative question (Strauss, 1987) was simple: How do studio teachers plan the project assignment and the ensuing instruction?

The present paper is one of two[1] emerging from this overall

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[1] Another paper, "Influences on College Teachers' Planning for the Project Assignment," submitted for publication December 1989, describes findings about the factors influencing teachers'

investigation. In this paper, after introducing the study's theoretical foundations and methods we report here our findings about the two essential elements of teaching in an apprentice setting through a project assignment -- designing a good assignment and helping the students engage and learn from it. We conclude with observations on the further study and refinement of apprentice teaching in higher education.

THEORETICAL BACKGROUND

The overall investigation was driven by several sources of theoretical work, some pertaining directly to teachers' planning and others more relevant to academic tasks such as the project assignment.

While input-output models (objectives, activities, instructional delivery and evaluation) have structured much of the research on college instructional planning, recent research has illuminated and contradicted those models (Andresen, Barrett, Powell, and Wieneke, 1985; Stark, et al., 1988). Research conducted with teachers of younger students also contradicts simplistic systems models of teacher planning. Clark and Yinger's (1987) research revealed teacher planning as a "complex and fluid design process" (p. 84) in which teachers are specialists in "designing practical courses of action in complex situations" (p. 99). Clark and Yinger's discussion reaffirms the inappropriateness of rigid conceptions of planning based in instructional strategies or objectives. In the light of these reconceptualizations, this study was designed to explore the complex and fluid design process of planning for the project assignment.

This study was also influenced by the work of several researchers who have recently emphasized the important effect that college teachers' beliefs, theories, and views of instruction will have upon their teaching. Stark and her colleagues found, for example, that both the characteristics of the field itself and the teacher's beliefs were extremely difficult to separate from their overall thinking about instructional planning (1988, p. 5). Andresen and his colleagues also found "theoretical views and beliefs about teaching and learning that underpin the ways in which teaching is organized and conducted" and concluded that further investigations should "provide clues to the implicit theories of education held by teachers" (Andresen, et al., 1985, p. 326). These implicit views of education would be particularly important in apprentice settings without rigid curricular requirements or course specifications.

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planning. The investigation's technical report, "College Teachers' Thinking and Planning: A Qualitative Study in the Design Studio," sent to ERIC in September 1989 for cataloguing, describes the entire investigation in detail.

In fields such as engineering, pediatrics, or journalism, conceptions of "the task" are especially important because learning takes place chiefly through the reciprocity of student performance with teacher comment on that performance. In this type of teaching, then, it is essential to highlight the task, the student's performance (which can be conceived as the student's response to the assignment), and the response of the teacher to that performance. Doyle first introduced the concept of "academic task" as an analytical tool for conceptualizing and examining how subject matter is enacted in the classroom (1983, 1986). For higher education in particular, McKeachie and his colleagues (1986) pointed out that academic tasks can be conceptualized in various ways, particularly citing Doyle's model.

The academic task is obviously the focus of studio teaching. Yet considering its centrality, studio teaching has received surprisingly little research attention. Schon's work on the nature of practice (1983) and his inquiries into instruction for professional practice (1987) both rested in his early interest in the studio. Studying landscape architects, Bray (1988) used stimulated recall to investigate how instructors think in both large group and studio settings, and to explore teaching improvement, finding variation due largely to teacher experience, and Dinham (1987) discerned eight major themes in studio teaching, of which two addressed matters of teacher planning for assignments: the teacher's ideas about teaching and learning, and the manner in which the teacher responds to students and their studio performance.

METHOD

The investigation reported here, drawing from these streams of theoretical work and previous research, rested in an interpretive naturalistic paradigm, raising questions answerable only through exploratory methods employed in a naturalistic setting, through context-responsive approaches yielding narrative data. The study was bounded by its focus on the studio as a surrogate for the many "applied" settings in which college apprentice learning and teaching occurs, and within the studio it concentrated on the teaching connected to the problem assignment. Excluded were other influences such as the physical setting and extra-studio curriculum. This study was context-bound also by the investigators' academic heritage in psychological (as contrasted with, for example, marxian or socio-linguistic) interpretations of the forces and actions important in teaching, together with their consequent tendency to design a systematic (Smith, 1987) rather than emergent study.

The study's two teachers are very much like the kinds of teachers usually found in college studios. One is a senior, distinguished

faculty member with a national reputation in his specialty. The other, a younger instructor with a good teaching reputation who teaches half time and maintains a private architectural practice, had been his co-teacher in other semesters. The assignment was an urban design problem on which students worked for ten weeks of the fifteen-week semester, analyzing three major traffic corridors, studying several adjacent square mile areas, and proposing new solutions. Both teachers were personally and professionally intensely interested in the complicated problems of urban reform in growing cities.

Data Sources

To address the triangulation/validity complexities of investigating teachers' planning, this study sought multiple perspectives wherever possible. We (1) two investigators (2) followed the teaching throughout an entire semester. Because this course was taught by two teachers jointly responsible for this advanced studio, we therefore could collect data not only from (3) directly questioning both of them but also from (4) observing exchanges between them. In addition, (5) the teachers presented the assignment to their class not once or twice but three times early in the semester. Altogether the opportunities for triangulation recommended by Yinger (1987) were designed into this study, although we were mindful also of the cautions about triangulation enunciated by Mathisen (1988).

The several direct and indirect sources of information constituted the study's "sample" of data, as described by Goetz and LeCompte (1984), Lincoln and Guba (1985) and Miles and Huberman (1984). Individual interviews with the two teachers provided the richest source of data for this study. Conducted early in the project, the interviews elicited a range of views from the broadest to the most specific conceptions of teaching. Our most important guide in the construction of the questions was Spradley (1979).

A second source of data was the two teachers' conversations about the project; we called these "brain storming" sessions. The more substantial session occurred just before the assignment was to be presented to students for the first time; the teachers met not only to resolve current student uncertainty about directions, but also to map out the project more generally. The second brainstorm, later in the semester, was a more casual discussion about student difficulty and organization.

The third data source was three sources: the teachers' successive presentations of the problem assignment to the students. The first was a quick overview of the assignment; students were advised to think about the issues the project might address to prepare for a more complete presentation at the next class session. This presentation drew explanations and project

ideas from the theoretical frame the teachers had chosen for the project (Lynch, 1960), and addressed student questions. The second, more lengthy, project presentation addressed both the project's conceptual possibilities and its requirements. The teachers alternated providing illustrations drawn from problems in the local community. The third assignment presentation emphasized the project timetable and focused on the requirements students would meet at each stage in the project. The teachers emphasized the project's vast possibilities and students' opportunities for individual decision making, and on occasion overtly refused to be specific when students requested details. Students were more actively involved in this session, clarifying logistics and at some points helping to resolve dilemmas about requirements.

Data Reduction

The observation and interview narratives were recorded on typescripts; these constituted the first level of data. These raw data were analyzed by the methods outlined by Strauss (1987, p. 23-25). The first pass through the raw data was a rough "scanning," whose notes (second level) yielded myriad topics, themes, comments, hypotheses, and exclamations. Grouped and sorted, these topics became the first set of codes (third level) for classifying the data. The process generated also a number of memos (level four), including emergent themes. The 29 provisional categories were used to analyze the typescripts line by line for evidence pertaining to these 29 topics. Category refinements inevitably resulted, for a total of (level five) 42 categories, and extensive interpretive notes (level six) were added by both investigators. Then, using a locally-designed WordPerfectMacro, the passages coded for each of the 42 categories were extracted from their respective texts and 42 new document files were created, the thinnest of which contained two (ultimately combined with another) and the thickest 89 passages. These passages provided the substance for developing the study's "findings."

During the data reduction process, from initial scanning to the master set of categories, successive model-building attempts (in the manner discussed by Strauss [1987, p. 185]) were memoed. The most satisfactory model, evolving after several provisional coding schemes had been attempted, combined the best elements of all previous solutions. This model, illustrated in Figure 1, shows two major elements. The first illustrates influences upon teachers' thinking and planning (teacher conceptual frame, teacher view of students, and the personal experience of teaching), all of which contribute to defining appropriate design teaching. These influences are discussed elsewhere.[2] The

[2] See footnote 1.

model's second major element illustrates the "essence" of teaching as explained by one teacher:

> "I really think that there are two parts to [teaching] studio: one is thinking of a good problem and the other is helping students through a solution. That's right -- there really are two parts, and those are the two jobs we have as teachers -- to think [about] those two pieces."

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Figure 1: Model for Teaching through the Project Assignment

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THE TWO COMPONENTS OF STUDIO TEACHING

These two pieces of the teacher's job were the focus of this research. We explored how teachers think about these two pieces, verifying their reports through observation in their interchanges and in the studio with students.

Designing a Good Problem

As with other design tasks, designing an educational experience is a complicated matter. The process rests in the most abstract -- the theoretical foundations of the field and the teachers' own conceptions of what constitutes appropriate design teaching -- and it extends to the most specific -- the details of student work and teacher action. This study found six themes pervading teachers' design of studio problems.

Multiple Goals. These teachers' design problem served several purposes, including intended effects on the urban community, certain effects on students, and therefore strategies for teaching. The first was that the project would

> have the potential of making a real, positive contribution to the general public [because it is] directly applicable to real problems in the community.

This goal evolved directly from the teachers' commitment to urban planning as a way for better social environments to be constructed. Related to this goal was another:

> to change the students' perception ... to get them to see it in a way they haven't seen it before

and as part of accomplishing this, the teachers were

> trying to build up their vocabulary ... the sort of range of answers ... whole new ways of solving problems or looking at problems ... [he continues later] if education does anything it sort of rattles your cage and changes your perception about a whole lot of things

Another mechanism for bringing about the perceptual change was that students would be "working in an unfamiliar medium," as one teacher put it. The "scale is a little different than they're used to," explained the other, "it is at the same time very similar to stuff they've done, and also very different."

These hopes for social influence and students' perceptual change implied certain strategies for bringing about these changes:

> One of the other purposes is to let them practice developing a rationale to go along with whatever they propose as solutions to these urban problems. And we find that's sometimes very difficult. People seem to come to us bright enough and have been through all the education and yet they have a hard time making a logical argument for a set of ideas

And later:

> we hope that the whole experience is confidence building,

These abstract goals, more specific purposes, and strategies for achieving them are not separate but interwoven. For example, the teachers' social commitment to urban improvement was woven into their understanding that students need substantial perceptual changes. Students' presentations to lay audiences would be one vehicle through which they themselves would assume these perceptual changes, as well as being a mechanism for learning to present a logical argument persuasively.

A theoretical base. According to these teachers a good design project rests in important design principles. The theoretical framework explicated by Lynch (1960) that guided these teachers' and students' thinking throughout the semester -- particularly in the all-important early days of the project. The Lynch framework first appeared in the two teachers' brainstorming session, in which they generated themes they would discuss as they presented the assignment. In the brainstorm, the two discussed categories such as points, destinations, intersections, loops/lines, mode changes, and districts as general features of the urban environment. In the first presentation to students the teachers emphasized how the theoretical framework would be useful in the future in approaching all urban design problems. Each student received a photocopy of the Lynch chapter, and later (after explaining that one goal of the assignment was to develop

alternative ways of looking at a site) the teachers discussed elements of one traffic corridor in terms of "nodes," "landmarks," and "magnets."

In the second presentation the theoretical framework unfolded further. More extended examples were given for several categories, for instance:

> I'll talk about radials [says one teacher] -- the radial should have something to do with magnets. But for this assignment, concentrate on the path, not the magnet. An example we have [from a previous semester] is a junior high school bike path: the radial study looked at junior highs, and the key was bike riding.

One teacher explained in his interview:

> We're interested in looking at theoretical questions but in a practical context ... that might apply to a whole range of situations in [this city] or somewhere else. We've described those generic categories of paths and edges and districts and landmarks and nodes, and tried to give some kind of theoretical basis for what they're doing. On the other hand I think we made a great effort to make it very, very specific and very very practical ... they are forced to deal with theoretical questions in a very practical context.

The larger curriculum. This studio assignment fit at a particular point into the school's larger curriculum, but was distinct from students' earlier semesters. The teachers explained that building on prior work helps ensure students' confidence that they can be successful with new, more complex projects:

> By this year and maybe in the earlier semester in fourth year, we begin to change the problem. And we say, "now wait a minute, it's not always going to be the same, but look what tools you can bring from what you've been learning to this new situation. ... A whole bunch of things might have changed but remember what is the same."

> We hope that the whole experience is confidence building in that we change a whole bunch of things on them, but they realize that they can make that transfer, that shift, that translation from the problems they've been used to, to this larger, more complicated, more generalized problem.

Yet this complex fifth year project was substantially different from the students' past experiences. One instructor explained

> Typically in architecture [studio courses] you give them a very specific problem with a lot of very clear parameters

> ... we're not doing that. We're giving them a general topic and asking them to both define the problem and come up with the solution.

The differences between this project and students' earlier experiences extended beyond problem definition into its execution as well:

> We couldn't teach this studio really until fifth year, when they start being comfortable with responsibility for assembling the project and budgeting their time for working with stuff all around .. it's not to say that <u>all</u> fifth year students are very good at that, but the best ones will do very well at it. ... It is at the same time very similar to stuff they've done and also very different.

How a given semester differs from the curriculum at large depends, of course, upon how the curriculum is conceived. These teachers described different conceptions of the curriculum at differing points in the project. One dismissed the traditional view of architectural curricula, proposing another scheme that would require a more integrated, school-wide agreement about teaching:

> I started to say most people who have to describe what goes on in this college find it easy to say, "well, we start with small simple problems and we end up in fifth year with big complicated problems." I think that sounds nice, right? But I think the way it's more useful to think of architectural problems is based on the design process -- on the cycle [of analysis, thinking-through-graphics, re-analysis, penultimate products, etc].

This conception of the ideally design curriculum is shared by his co-teacher, who explained his vision using different language:

> There are lots of ways to organize a curriculum. This curriculum is organized one way; there are very different ways to organize it that would ultimately be as successful. ... I suspect you can organize it in ten different ways and they would all be equally successful. If you wound up teaching the full matrix it doesn't matter if you end up organizing it by the vertical axis or the horizontal axis you're ultimately going to get a everything on that matrix anyway.

<u>The problem as prototype</u>. Both in discussing their teaching and in the problem presentations these teachers emphasized the importance of treating the studio design problem as a prototype of all design problems. On showing students the power of prototypes in their thinking, one said:

> So the student is trying to solve this problem, for this building, for this client, for this function on this site, but ... you've got to pose the problem in such a way that they see that there's a lot of transferable learning, that they're learning how to solve this problem but meanwhile they're learning how to solve problems like this, and maybe even how to solve problems apparently not very much like [this]. ... And that's, I think, one of the most interesting things about education: approaching problems in a kind of prototypical way ... if you can get them to see that what they're doing has not just application in this course, in this problem, or this year of their lives but it has repeated application.

Although this may be the wisest way to teach -- and perhaps to function professionally -- the focus on prototypes may contradict some of the designer's creative instincts:

> I think there's a kind of weakness in our profession, because we're trained to look for the particular, unique kind of qualities in any problem, as a way of making our buildings different from one another. ... But I think it's even more interesting to approach problems as if you are trying to learn in the design of this problem some things you can apply to other problems or maybe even all problems.

The latter view prevails for these teachers in this studio -- they mentioned that the ideal problem has a generic quality and their purpose in this assignment was to emphasize the usefulness of the prototype. They had selected the Lynch theoretical framework to underpin the studio assignment, and used it in presentations to and later discussions with students. They had known that for particular studio problem to be a successful "fit" within the larger venture of teaching architecture they would need to "write the problem and talk about the problem as if it is a prototype of other problems."

> I think the other thing that's exciting about teaching architecture is [that] you can make analogies from that to all kinds of things -- whenever you think about anything that has to do with human choice or about the way you make intellectual categories ... they take whatever they learn in a college course, and if it's transferable then it's great.

<u>Pertinence for professional practice</u>. The image of professional practice permeated teachers' remarks, problem definition and requirements, and students' concerns. For example, presentation techniques are important, the teachers explained, because three dimensional representation is necessary in solving real urban planning problems. In other kinds of architectural practice, as well, concrete representations of the problem are important because

> you can't any longer sit in a chair in a coffee shop and think about the problem. You have to go where the problem is and where it is represented in your models and in your drawings in order to see the complexity of it.

Other similarities to office practice were woven into this project. For example, the teachers emphasized prototypes because

> typically a student will go into an office and the first job they get is to add a bedroom to somebody's house and the house is ugly to begin with

so teachers must show students how to think of even the most prosaic problem as a prototype of a larger issue -- presumably a sanity-saving technique with bedroom additions and other uninspiring projects.

In fact realism makes the problem more meaningful for students.

> To me [learning is] a lot more realistic if the problem is realistic; if it obviously is a problem. That's why, when I was in school we'd have problems like designing the entrance way to some sultan's estate or some baron's castle, someone would say, "now is this a really serious problem in this world?"

This view of a good problem reveals these teachers' grounding in theoretically based professional practice, and contradicts other historically fashionable views of architecture studio teaching, in which imaginary design problems are used for their purely abstract value.

Importance of the product. A good problem acknowledges the importance of design products not only in practice but also for students' learning.

> You don't develop a design in the abstract and then figure out a way to present it. The process of presenting and drawing is part of discovering design. ... The fact that we're talking about products before they've started is an indication of how important a part of the design process that must be. Otherwise we wouldn't talk about products until they were finished.

Early in the project these teachers and the students together specified the project's expected products, not simply to specify course "objectives," or to inject "relevance," but because development of the design product is the vehicle through which students' best design thinking and learning occurs. Designers in practice live and think through their drawings, said one of the teachers, and the problem's visual representations elicit the

designer's best thinking about the problem's discovery and resolution.

Expectations for studio products are therefore carefully planned. For these two teachers, the brainstorming session included a swift exchange about the most appropriate products to require of the students. Later, in reflecting on his own teaching, one teacher revealed the importance -- for him -- of the visual, and especially the graphic, in his thinking. His remarks summarize not only the significance of the tangible product in design teaching but also the intrinsic role graphic representations play in his own thinking:

> I draw a lot. And I try to draw as much as I can because I believe that's the form of architecture. I don't think architecture is a verbal art. I don't think there is such a thing as a verbal architecture idea. I think without some sort of graphic or three-dimensional model, you're just talking about words, [and] words are an inappropriate means of communication for our thing. ... I think it's really important -- to my way of thinking -- to communicate graphically.

What constitutes a good design problem? When designing a good studio problem, these teachers keep in mind what students must do to learn from the problem, they are attentive therefore to how the problem must be crafted, and they are watchful about the end product. These teachers said that a good problem requires students to analyze and then to synthesize the problem's requirements, and to communicate the problem's resolution to others. The great number of skills involved in design must all be honed throughout the curriculum; a good problem meshes with the curriculum but extends students' prior learning into new areas. A good problem also balances teacher-imposed direction with student initiative, as Dinham (1987) found.

After pondering the attributes of a good design problem, one teacher offered a simple summary:

> They go through it and hopefully know more about their profession when they're finished than when they started. A successful problem is one where you learn a lot, and an unsuccessful problem is one where you learn very little.

Helping Students through a Solution

How do teachers help students learn "a lot?" While teaching may rest in the conceptual frame that teachers bring to teaching, and in the design of the project assignment, the full picture is incomplete without attention to actual instructional strategies -- the techniques used in communicating with students through the

duration of the project. Five themes emerged in this examination of teachers' instructional strategies.

Logistical arrangements. First, teachers made arrangements so the students could engage and pursue the task set out in the assignment. They also took steps to "unparalyze" students by requiring tangible beginning steps and they carefully designed the deadlines to permit a successful beginning and yet to urge students onward through the project:

> I think the only way to get students moving is to give them deadlines. They have a hard time beginning a project so unless you give them those first one or two landmarks of where you want them to be at what time, they in fact will take two-thirds of the length of the project to get started on it.

Further, they gave students the opportunity to present and refine their projects several times during the semester:

> If you have to explain a problem to someone else, then it's a real good way of explaining it to yourself, which is really what they need to do ... .

Influencing student perception. Teachers also influence how the students think about the problem. In addition to helping students see a problem as a prototype of a broad classification of problems, the teachers also hope to give them confidence that skills previously learned will apply in new ways to the new problem. In the last year of the curriculum the teachers change the nature of the problem assignment, but to strengthen students' confidence they

> help them with a method, with the design process ... so that when you walk away you not only leave them with suggestions as to what to do but you leave them suggestions of ... three or four ways of doing that.

Encouraging progress. Teachers not only influence students' initial views of and confidence about the project assignment, but also, thirdly, deal with the students in ways that will help them make progress toward a solution. The teachers spoke of teaching as a diagnostic process, for example when they cannot determine whether the student is unable to understand the problem or is not giving it enough effort. They employed structural techniques for gleaning the best from their students: both in their interviews and in presenting the project to the students the teachers mentioned high expectations and "lots of responsibility."

Both teachers emphasized also that they themselves play an important role in ensuring success for all students:

> the goal in any design problem for both the teacher and the student is that everybody in the class succeeds over a certain threshold
>
> You want to give them as much of an opportunity to succeed in the project as you can.

They also "constantly redefine" the problem for students, at some times broadening the student's vision and at other times narrowing the focus.
They fully expect good ideas from their students, and see their role as improving on those. They explained that

> you've got to critically respond to what they do; the best way is to make positive suggestions, not just tell them how bad it is and walk away. So you leave them with something, and not just one suggestion but if you can, three or four suggestions ... you want to try to find some ideas that are their ideas that they contributed

Openings and closings. Perhaps the single most vivid instructional strategy in this study's findings was the teachers' fine balance between "opening" the problem -- the possibilities for the students -- and "closing" or narrowing the problem. From the start, in their brainstorming session, the two teachers agreed (in the words of the observer) that while "they needed to get students into the next part of the problem, yet there was a need to hold off a little" and see where they would need to "reconceptualize the task for students when the situation is ambiguous for them." On the one hand they must help students focus, while on the other they must keep the possibilities open.

Students themselves are one reason for the need to balance opening and closing. Some students

> just keep opening doors. They're what somebody calls divergent thinkers. ... They keep discovering things, but you have to really work with them to get them to close the problem, to finish and actually do something. And others just open the front door and say, "oh, I know what this is; it should be round and eight stories high," and [for] those you have to give techniques to reopen their mind again and again.

The other teacher explained openings and closings in another way. Early in the project he said managing students' "tendency to shy away from problems that seem to be open-ended and difficult" is the teacher's most delicate challenge. The teachers managed this challenge in the way they explained the curriculum to students, and in their design of the specific project assignment:

> I think anytime educationally you can hold a few things the same but change almost everything else and have students apply their knowledge, their abilities, their sort of intelligence in a completely different situation that they've never had before, that is a tremendous confidence builder and really good for their intellectual flexibility

What, then, do teachers do to help students through their resolution of unstructured, difficult design problems? In a word, they strike a fine balance. Particularly at the start of the problem, the teachers held the problem open, particularly in the face of student pressure for closure. For example even in arranging student choice of project categories (magnets, radials, vacant property, etc.) they left the possibilities open:

> I want you to raise your hands guessing what will be your choice -- then we'll go over the detail of what you would do for each; then we'll go back to see if in over-booked categories people will change their minds. It would be nice if you were flexible as to location.

Early in the project, examples were also used to balance opening with closing. The teachers gave concrete examples of the factors students could deal with in each aspect of the project, but their cascade of examples was illustrative rather than directive. Further into the project they used class meetings to expand and continuously redefine the students' vision of the project's possibilities while in individual discussions with students they worked with each student to shape and narrow the project to suit the student's abilities and interests. Indeed, a vital aspect of teaching for these two teachers was refocusing the problem for each student as necessary:

> Sometimes people solve the problem the very first time or the second time. So then we have to open up some other problems that are tangential to that problem, and say "look you've got that fine, but why don't you think about this, or could you do this." Or -- we'll push them to make a little bit more sophisticated presentation or communication of it.

In each case, however, the goal is maximum learning:

> We have both problems [projects to be narrowed and those to be broadened] but in each case, in every case we can, we sort of restate the problem and always with the hope, if you're lucky, of having the best possible result in the end.

Improvisation. Much of skillful teaching is improvisation, as Yinger (1987a) has illustrated. Our more senior teacher provided our most vivid metaphor for improvisation:

> Well, like Harrison Ford said in one of those movies, "I'm just making this up as I go along." You know, after one of those incredible sequences.

Just as for Harrison Ford's film character, however, for teachers "making it up as I go along" rests on vast experience, skill, knowledge, and the ability to assess and respond to complex circumstances. Indeed, improvisation is expected, and even desirable, and therefore planned for. Moreover, improvisation is not only important in teaching but is also an integral part of the design process:

> Because some of the things just happen, you know. I see something in the drawing I'm making that was unintended, but I see a way of making a relationship because of some other things I saw -- out of memory -- completely below the level of my consciousness. I see some ways of putting things together that I hadn't seen before.

CONCLUSIONS ABOUT TEACHERS' PLANNING FOR THE PROJECT ASSIGNMENT

This investigation attempted to "showed studio teaching together," to show its complexity in ways that "haven't been seen before." A good problem, according to these teachers, serves multiple goals and purposes, rests in a theoretical frame that can be generalized to other design problems, and builds on and meshes with the existing curriculum while providing students new opportunities to advance their learning. A good problem is designed to be prototypic, to employ the studio product as a mechanism through which students will learn the design process, to teach important aspects of professional practice, and to use presentation methods not only as a way of communicating results but more importantly as a way for students to think through the design process itself. When teachers work with students developing solutions to these problems, their instructional strategies are carefully designed. Their decisions on task sequencing and their confidence-building efforts influence both task engagement and progress. They strike the delicate balance between opening (and re-opening) the problem's possibilities, especially early in the project, and showing students how and when to narrow and focus their work toward a solution. Throughout this process, as throughout designing, an experienced teacher skilfully improvises.

Teaching as a Complex and Fluid Design Process

These findings confirm Clark and Yinger's assertion that teaching is both complex and fluid (1987, p. 84), and contradict the popular "rational, logical, industrial" systems models of

instructional planning that long dominated the instructional planning literature (Zahorik, 1975). The teachers in this study demonstrated Clark and Yinger's picture of specialists designing practical courses of action in this complex situation. They maintained careful balance among multiple goals and purposes, drew broad lessons from tangible prototypes, and emphasized the recursiveness in producing products and refining one's design thinking through successive solutions. They improvised not only in designing the project's specifications but also in adjusting the project's dimensions throughout the semester, in separately encouraging each student, and throughout in "opening" and "closing" the project to meet the class' and individual students' needs and potential.

Views of Teaching and Learning

This examination of teaching through the project assignment has confirmed that the actions of teaching rest in important ways on teachers' "rich store of knowledge" that "affects their planning and their interactive thoughts and decisions (Clark & Peterson, 1986, p. 258). As Figure 1 shows, this study found teachers' conceptions about effective studio teaching resting in their conceptual frame (including their world view and their views of design and the design process), their views of students (including student characteristics, student need for success and confidence, and how students' might display their thinking), and teachers' own personal experience of teaching (including its risks and rewards). Then, when explaining their design of problem assignments and their actions with students in the studio, these teachers expressed the kinds of beliefs about teaching and learning that Fenstermacher (1986) and his colleagues have termed "practical arguments," a term "derived from Aristotle's differentiation between theoretical wisdom and practical wisdom," (p. 43) referring to ways teachers' beliefs and classroom actions can be linked. These teachers offered arguments directly linked by their own words and examples to their classroom actions, for example

> I think it's even more interesting to approach problems as if you are trying to learn in the design of this problem some things you can apply to other problems or maybe even all problems.

The findings of this study differ substantially, however, from those summarized in Clark and Peterson's (1986, p. 266) overview of studies linking teacher planning and action. Those studies focused exclusively on preschool to 12th grade teachers, and concerned traditional classroom subjects or lessons. Clearly the link between thinking/planning and actions in the practical setting of the studio with adult learners calls for more a different kind of analysis.

The Project as the Academic Task

In the end, the teaching strategy of the design studio is the project. As Doyle (1986) has proposed in offering the concept of the "academic task" as an analytical tool for studying instruction, the knowledge that teachers seek to develop in their students is manifest through the tasks teachers present to students. Tasks communicate the curriculum to students, he proposes, and, thus, tasks shape their learning in fundamental ways (p.366). Academic tasks provide the setting that governs student information processing (Doyle & Carter, 1984). Moreover, particularly in professional fields, knowledge is "situated;" that is, it is folly to assume that conceptual knowledge can be learned with any depth and retention without attention to the situations in which it is learned and used (Brown, Collins & Duguid, 1989).

Task design is especially important in tasks requiring students to produce solutions to ambiguous problems, rather than merely reproducing already established information or applications. Indeed, academic tasks of any complexity whatever always present the twin challenges of risk and ambiguity, challenges described convincingly by Doyle (1986) and Doyle and Carter (1984). For postsecondary professional education as well as for classrooms of youngsters, "it seems reasonable to expect that the actions of teachers and students in managing ambiguity and risk will affect the nature of the academic work that is accomplished" (Doyle & Carter, 1984, p. 131). In the present study, these twin factors -- and especially task ambiguity -- substantially influenced both the way teachers planned for the studio assignment and the responses students gave to it. Doyle proposes that teachers can constructively, intentionally include a carefully designed ambiguity into academic task assignments, in order to accomplish certain goals. The study's two teachers did exactly this, as the findings demonstrated. Doyle and Carter's research showed further that as tasks were pursued in the classroom, "there was a clear drift toward greater explicitness and specificity of judgments students were required to make on their own," as teachers clarified and specified "the features of an acceptable project" (1984, p. 145). For this study's teachers this drift was expected, and indeed was part of their strategy for dealing with students of individual abilities individually -- and particularly for dealing with students having problems.

The balance of ambiguity with focus, and risk with certainty, occurs in all classrooms. Students will "influence task demands directly by asking public and private questions about content and procedures" (Doyle & Carter, 1984, p. 145). Sometimes the questions are disguised; for example, Fong (1987) points out that when college students ask "Will this be on the exam" they often are really saying "This is an important point, isn't it?"

Students do consistently, whether indirectly or directly, seek to reduce ambiguity and risk by clarifying task demands and seeking feedback about their work.

Balancing these factors becomes the core of teaching through academic tasks. On the one hand, students learn better through tasks that present challenging ambiguity because they must learn to think on their own; on the other hand too much ambiguity not only impedes learning but fosters discouragement. The teacher's dilemma, even in a virtually risk-free environment like the senior design studio, is that with reduced ambiguity the task can swiftly lose its instructional merit. "If one accepts the view ... that learning to be an expert requires that students make real-life interpretations and decisions, then familiarization of novel work is a cause for concern because it truncates the curriculum" (Doyle, 1986, p. 374). Students whose task requirements have been simplified may be able to accomplish the task more easily but opportunities for challenge are lost and students are robbed of the opportunities to rehearse the complexities of professional practice.

When teachers design the academic task they are designing their best attempt to elicit student learning. In designing a project to motivate the greatest student learning they will balance multiple opportunities to succeed or fail against the requirement of a polished, professional final product. They will plan to develop students' thinking through graphic representation; they will recognize the importance of a realistic project, and most important, they will understand the balance between opening project opportunities for the students and closing down options that would lead students in unproductive directions. In helping students through their solutions, they understand the role of "getting started," as this study's teachers described it, and appreciate the reasons for students' natural tendency to negotiate reduced task ambiguity by demanding certainty. In their work with individual students their guidance will extend from making logistical arrangements for the studio's tasks to be accomplished to dealing with students individually in ways that will expand their thinking. Throughout, the task is the vehicle through which students' learning develops and expands.

Findings Related to Previous Work on Studio Teaching

Three themes have dominated the sparse research on studio teaching: teachers' thinking and planning, the actions of students and teachers in the studio, and the jury as a pedagogical technique. Clark and Peterson's (1986) model of teacher thought and action offers a useful scheme for examining these themes.

The "jury" system for design evaluation is the most controversial aspect of design studio teaching. While he jury has been the subject of much discussion, heated argument, and considerable controversy (Anthony, 1987; Braaten, 1964; Carlihan, 1976; Dinham, 1985; Dutton, 1987; Malecha, 1983), only Anthony (1987) has attempted serious, systematic study of the jury system. Anthony's study found that the vast majority of participating faculty, students, and practicing architects believe architectural juries need improvement. Students reported learning very little from juries -- although more from interim than final juries. Most student reported feeling defensive and nervous in their juries, and reported tension and "burnout" that greatly interferes with learning. Anthony found, too, that the "architecture student 'subculture' differs substantially from that of other students, and that it may well be harmful to students' health" (p. 3). These influential findings are discussed and the pointed recommendations cited whenever reform of architectural studio instruction is addressed.

The second theme pervading the research literature on studio teaching -- the actions of students and teachers in the studio --has been the subject of only two empirical studies, both encompassing the three aspects of Clark and Peterson's explication of teachers' actions and effects: teachers' classroom behavior, students' classroom behavior, and student achievement. The ambitious Architectural Education Study (Porter & Kilbridge, 1978) examined studio instruction minutely, yielding not only rich descriptions of studio life and poignant findings but also thoughtful essays on the nature and future of design education. More recently, Dinham's (1987) studies in the design studios of four architecture schools elaborated eight general categories of teacher action and teacher/student exchange:

teacher philosophies/views manifest in teaching
teacher ideas about teaching and learning
student preparation before studio instruction
the role of time in studio teaching/learning
teacher judgments/feelings regarding students
two-way teacher/student communication
student talk
teacher guidance based on student work

While these categories might form a useful taxomony for discussing or improving studio teaching, however, actions are always based on thoughts. The research on teacher thought illuminates teacher action in many ways, as Clark and Peterson (1986, p.258) observe. The third theme in research on studio teaching -- teachers' thinking and planning -- has been pursued in two recent studies: Bray's (1988), and the larger

investigation[3] from which the present report springs. Many of Clark and Peterson's conceptions of research on teachers' thought processes appeared in Bray's explorations of one design faculty's reports of their (studio as well as classroom) thinking processes. Bray extracted five categories of findings from studying these teachers: the teacher's purposes/intentions for students' learning, the content or substance of the instruction, instructional procedures and materials/environment, students' existing states, and teacher self-awareness.

In contrast to Bray's work, the present study's findings about designing a good studio project and helping students through a solution merge the conceptions of teacher thinking and planning Clark and Peterson discuss with the essentials of teacher action and its effects. These findings showed that, as Clark and Peterson emphasize, thought and action are not only related but reciprocal: not only does teacher thinking affect action, as expected, but teachers' actions and their effects clearly affect their subsequent thinking and planning as well. Studying teachers' thinking is inextricably related to studying teachers' actions and their consequences.

The vast complexity of teaching as represented in Clark and Peterson's model of teacher thought and action has only superficially been tapped by the research to date on the teaching of design. The possibilities for further investigation are many, and could prove doubly fruitful; not only is it illuminating to study studio teaching, but the findings can prove useful in the wider study of all apprentice teaching, for which this setting provides but one example.

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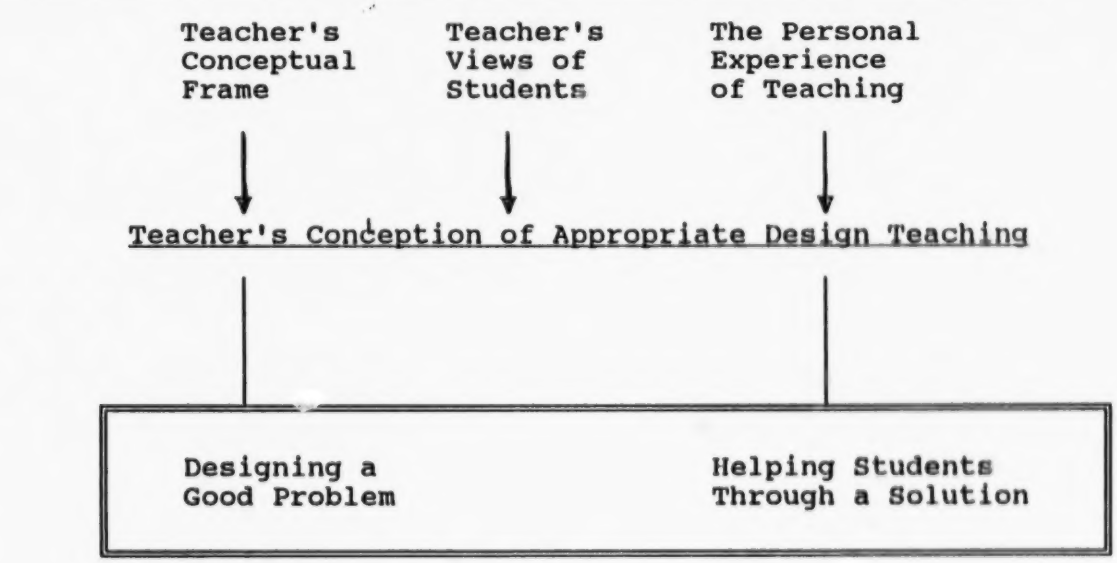
[3]See footnote 1.

Figure 1: *Model for Teaching through the Project Assignment*


Influences on Teachers' Planning for the Project Assignment:
Teacher's Conceptual Frame
Teacher's Views of Students
The Personal Experience of Teaching
Teacher's Conception of Appropriate Design Teaching
Designing a Good Problem
Helping Students Through a Solution

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